

REMARKS

I. Status Summary

Claims 1, 2, 5-8, 10 and 11 are pending in the present application. Claims 1, 2, 5-8, 10 and 11 have been examined by the U.S. Patent and Trademark Office (hereinafter "the Patent Office") and currently stand rejected.

Claims 1, 2, 5, and 6 have been amended. New claims 12 and 13 have been added. Support for the amendments can be found in the instant application as filed. No new matter has been added.

Reconsideration of the application in view of the amendments and the remarks set forth herein below is respectfully requested.

II. Response to Rejections under 35 U.S.C. § 102(b) and/or 35 U.S.C. § 103(a) over Zabinski

Claims 2, 7-8, and 10 have been rejected under 35 U.S.C. § 102(b) and/or 35 U.S.C. § 103(a) as allegedly being anticipated by or unpatentable over U.S. Statutory Invention Registration H1,924 to Zabinski et al. (hereinafter "Zabinski"). The Patent Office contends that Zabinski teaches films comprising metal and amorphous carbon. The Patent Office concedes that Zabinski does not state "a film containing voids." However, the Patent Office contends that the film of Zabinski would inherently include voids.

After careful consideration of the rejection and of the Patent Office's comments, applicants respectfully traverse the rejection and offer the following remarks.

Initially, applicants respectfully submit that claim 2 has been amended to recite "at least one metal element selected from the group consisting of Zr, Hf and Y." Support for the amendment can be found in claim 2 as originally filed.

Applicants respectfully submit that claim 2 relates to a hydrogen storage material that is in the form of a film of amorphous carbon containing at least one metal element, Zr, Hf, or Y. As described in the instant specification, the presence of a metal element is a factor related to the hydrogen storage capabilities of the film. It is respectfully believed that the term "metal element" refers to metal in a form that easily combines with hydrogen to form a metallic hydride or interstitial hydride. See Instant

Specification, page 4, lines 14-17. The metal of claim 2 is not believed to be present in a carbide. For example, the instant specification describes that the percentage of metal can be controlled to make the formation of carbide less likely. See Instant Specification, page 4, lines 22-24. Applicants further note that the instant specification provides experimental evidence of the unsuitability of films comprising carbides for use as hydrogen storage materials. See, e.g., Instant Specification, page 12, lines 16-20, which describes a comparative example (i.e., Comparative Example 4) where a film having Ti present in a carbide form had relatively poor hydrogen occlusion ability.

In contrast to the metal element recited in claim 2, applicants respectfully submit that Zabinski appears to describe a composite comprising a nanocrystalline metal carbide, such as a TiC. See Zabinski, Abstract and column 3, lines 25-27. Applicants respectfully submit that, based on the evidence in the instant specification, the carbide-containing material of Zabinski would not appear have suitable hydrogen storage capabilities. It further follows that the material of Zabinski and the instantly claimed material are not inherently the same.

Claims 7, 8 and 10 depend from claim 2 and, therefore, include each and every element of claim 2. Thus, applicants respectfully submit that claims 7, 8, and 10 have also been distinguished from Zabinski.

Applicants respectfully request that the rejection of claims 2, 7, 8, and 10 under 35 U.S.C. § 102(b) and/or 35 U.S.C. § 103(a) over Zabinski be withdrawn and further ask that claims 2, 7, 8, and 10 be allowed at this time.

With further regard to any question of obviousness, applications respectfully submit that an allegation of obviousness based on even overlapping ranges can be rebutted by evidence showing the criticality of a range. See Manual of Patent Examining Procedure (hereinafter "MPEP") § 2144.05, citing *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990). Moreover, evidence of unobvious or unexpected advantageous properties can be enough to rebut a case of obviousness. See MPEP § 716.02(a), citing *In re Chupp*, 816 F.2d 643, 646, 2 USPQ2d 1437, 1439 (Fed. Cir. 1987). As described hereinabove, the instant specification provides teaching that the hydrogen storage capacity of the instantly claimed films can be related to the metal atomic %. In particular, the instant specification describes that the metal atomic

% range recited in claim 7 can be related to the hydrogen storage capability of the storage material and to keeping the metal from forming carbides. See e.g., Instant Specification, page 4, lines 19-24, which describes that when the metal atomic % is above 30%, the metal can form a carbide or carbide-like cluster, which makes the material unsuitable for use as a hydrogen storage material. Comparative films with higher or lower metal atomic percentages than those recited in claim 7 did not show good hydrogen occlusion ability. See Instant Specification, page 11, Table, Comparative Example 1 and Comparative Example 4. Thus, in view of the cited metal atomic %, at least the subject matter of claim 7 in particular is not taught or suggested by Zabinski. Thus, in particular, applicants respectfully request that the rejection with regard to claim 7 and claim 10, which depends directly from claim 7, be withdrawn and that claims 7 and 10 be allowed at this time.

III. Response to Rejections under 35 U.S.C. § 102(b) and/or 35 U.S.C. § 103(a) over Iwamura

Claims 2, 7, and 8 have been rejected under 35 U.S.C. § 102(b) and/or 35 U.S.C. § 103(a) as allegedly being anticipated by or unpatentable over U.S. Patent Application Publication No. 2001/0031346 to Iwamura (hereinafter "Iwamura"). The Patent Office contends that Iwamura teaches films comprising titanium and amorphous carbon and further containing voids.

After careful consideration of the rejection and of the Patent Office's comments, applicants respectfully traverse the rejection and offer the following remarks.

Initially, applicants further respectfully submit that claim 2 has been amended to recite "at least one metal element selected from the group consisting of Zr, Hf and Y." Support for the amendment can be found in claim 2 as originally filed.

Applicants respectfully submit that Iwamura at best is directed to a composition comprising amorphous carbon and Ti. Iwamura does not teach or suggest the film of claim 2 comprising a metal element Zr, Hf, or Y.

Claims 7 and 8 depend from claim 2 and, therefore, include each and every element of claim 2. Thus, applicants respectfully submit that claims 7 and 8 have also been distinguished from Iwamura.

Applicants respectfully request that the rejection of claims 2, 7, and 8 under 35 U.S.C. § 102(b) and/or 35 U.S.C. § 103(a) over Iwamura be withdrawn and further ask that claims 2, 7, and 8 be allowed at this time.

IV. Response to Rejections Rejections under 35 U.S.C. § 102(b) and/or 35 U.S.C. § 103(a) over Bauer

Claims 2, 7, and 8 have been rejected under 35 U.S.C. § 102(b) and/or 35 U.S.C. § 103(a) as allegedly being anticipated by or unpatentable over Bauer et al. (*Diamond and Related Materials* 2002, 11, 1139-1142; hereinafter "Bauer"). The Patent Office contends that Bauer teaches films of amorphous carbon and titanium. The Patent Office further contends that the films of Bauer inherently contain voids in view of their being prepared by magnetron sputtering.

After careful consideration of the rejection and of the Patent Office's comments, applicants respectfully traverse the rejection and offer the following remarks.

Initially, as described hereinabove, applicants respectfully submit that claim 2 has been amended to recite "at least one metal element selected from the group consisting of Zr, Hf and Y." Support for the amendment can be found in claim 2 as originally filed.

Applicants respectfully submit that Bauer at best describes compositions that comprise Ti. Bauer does not appear to teach or suggest a film comprising Zr, Hf, or Y. Thus, applicants respectfully believe that the subject matter of claim 2 has been distinguished from Bauer.

Moreover, the titanium in the composition of Bauer appears to be present in the form of a carbide. See Bauer, page 1140, left-hand column, first sentence of paragraph under "3. Characteristics of non-graded single layer films." As described hereinabove, the presently disclosed and claimed subject matter is not believed to contain metal carbides, as these are not believed to be particularly useful in hydrogen storage materials. See, e.g., Instant Specification, page 4, lines 14-22, and page 12, lines 16-20.

Claims 7 and 8 depend from claim 2 and, therefore, include each and every element of claim 2. Thus, applicants respectfully submit that claims 7 and 8 have also been distinguished from Bauer.

Applicants respectfully request that the rejection of claims 2, 7, and 8 under 35 U.S.C. § 102(b) and/or 35 U.S.C. § 103(a) over Bauer be withdrawn and further ask that claims 2, 7, and 8 be allowed at this time.

V. Response to Rejections Rejections under 35 U.S.C. § 103(a) over Zabinski in view of Takami

Claims 1 and 11 have been rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Zabinski in view of U.S. Patent No. 5,753,387 to Takami et al. (hereinafter "Takami"). The Patent Office contends that Zabinski teaches that density is a function of deposition rate, and that optimizing the density of the film would be within the skill of one of ordinary skill in the art. Further, the Patent Office contends that the presently claimed densities would be obvious as they relate to the optimization of a results-effective variable. Also, the Patent Office contends that claim 11 appears to relate to a density that reads on the density of amorphous carbon as evidenced by Takami.

After careful consideration of the rejection and of the Patent Office's comments, applicants respectfully traverse the rejection and offer the following remarks.

Initially, without acquiescing to the rejection and in an effort to expedite allowance of the subject application, applicants respectfully submit that claim 1 has been amended to recite "at least one metal element selected from the group consisting of Zr, Hf and Y." Support for the amendment can be found in claim 1 as originally filed.

Applicants respectfully submit that Zabinski appears to describe a composite comprising a nanocrystalline carbide, such as a TiC. See Zabinski, column 3, lines 25-27. In contrast, claim 1 relates to a hydrogen storage material that is in the form of a film of an amorphous carbon containing at least one metal element present at from 0.02 to 30 atomic %. As described hereinabove and in the instant specification, the presence of a metal element and/or the metal element atomic % are factors related to the hydrogen storage capabilities of the film. For example, as described in the instant specification at page 4, lines 14-25, the metal element easily combines with hydrogen to form a metal hydride or interstitial hydride. When the metal atomic % is above 30%, the metal can form a carbide or carbide-like cluster, which makes the material undesirable

for use as a hydrogen storage material. Applicants further note that the instant specification provides experimental evidence of the undesirability of films comprising a higher % of metal and/or metal carbides. For example, the instant specification at page 12, lines 16-20, describes that a comparative example where the content of Ti was 35 atomic % had relatively poor hydrogen occlusion ability. Thus, applicants respectfully submit that the carbide-containing materials of Zabinski do not teach or suggest the film of claim 1. In particular, applicants respectfully submit that Zabinski does not teach or suggest a hydrogen storage material comprising between a carbon film comprising 0.02 to 30 atomic % of a metal element Zr, Hf, or Y, such as that recited in claim 1.

Furthermore, with respect to previous arguments and the Patent Office's comments regarding the claiming of "columns," applicants respectfully submit that, although claim 1 does not specifically use the word "column", the presence of columns can be inferred from the recitation "a second region that extends in a thickness direction of the film." Applicants respectfully submit that one of skill in the art reading claim 1 would understand that this second region extending in a thickness direction is a columnar region. As noted in the response filed in the instant application on December 28, 2009, Zabinski does not teach or suggest a film comprising two regions, wherein the second region extends in a thickness direction of the film (i.e., where the second region forms a column in the first region) and has a different density than the first region.

Applicants respectfully believe that Takami is being cited for its alleged teaching with regard to the density of amorphous carbon. Takami does not cure the deficiencies of Zabinski with regard to amorphous carbon materials containing 0.02 to 30 atomic % of a metal element Zr, Hf, or Y. Thus, applicants respectfully submit that Zabinski and Takami, either alone or in combination, do not teach or suggest each and every element of claim 1.

Claim 11 depends from claim 1 and, therefore, includes each and every element of claim 1. Thus, applicants respectfully submit that claim 1 has also been distinguished from Zabinski and Takami.

Applicants respectfully request that the rejection of claims 1 and 11 under 35 U.S.C. § 103(a) over Zabinski and Takami be withdrawn and further ask that claims 1 and 11 be allowed at this time.

VI. Response to Rejections under 35 U.S.C. § 103(a) over Iwamura in view of Takami

Claims 1 and 11 have been rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Iwamura in view of Takami.

After careful consideration of the rejection and of the Patent Office's comments, applicants respectfully traverse the rejection and offer the following remarks.

Initially, without acquiescing to the rejection and in an effort to expedite allowance of the subject application, applicants respectfully submit that claim 1 has been amended to recite "at least one metal element selected from the group consisting of Zr, Hf and Y." Support for the amendment can be found in claim 1 as originally filed.

Applicants respectfully submit that claim 1 is directed to a material comprising amorphous carbon containing at least one metal element Zr, Hf, or Y. Applicants respectfully submit that, as described hereinabove, Iwamura at best describes a composition comprising titanium. Applicants respectfully believe that Takami is being cited for its alleged teaching with regard to the density of amorphous carbon. Takami does not cure the deficiencies of Iwamura with regard to amorphous carbon films containing Zr, Hf, or Y. Thus, applicants respectfully submit that Iwamura and Takami, either alone or in combination, do not teach or suggest each and every element of claim 1.

Claim 11 depends from claim 1 and, therefore, includes each and every element of claim 1. Thus, applicants respectfully submit that claim 1 has also been distinguished from Iwamura and Takami.

Applicants respectfully request that the rejection of claims 1 and 11 under 35 U.S.C. § 103(a) over Iwamura and Takami be withdrawn and further ask that claims 1 and 11 be allowed at this time.

VII. Response to Rejections under 35 U.S.C. § 102(b) and/or 35 U.S.C. § 103(a) over Kitabatake in view of Coats

Claim 5 has been rejected under 35 U.S.C. § 102(b) and/or 35 U.S.C. § 103(a) as allegedly being anticipated by or unpatentable over U.S. Patent No. 4,844,785 to Kitabatake et al. (hereinafter "Kitabatake") in view of U.S. Patent No. 3,480,575 to Coats

(hereinafter "Coats"). The Patent Office contends that Kitabatake teaches a source of carbon containing at least titanium and teaches forming an amorphous carbon film. The Patent Office further contends that, given that the metal was incorporated into the target, the film would inherently contain metal. Also, the Patent Office contends that Kitabatake teaches preparing the film at room temperature. The Patent Office appears to cite Coats as evidence that room temperature is less than 773 K.

After careful consideration of the rejection and of the Patent Office's comments, applicants respectfully traverse the rejection and offer the following remarks.

Initially, without acquiescing to the rejection and in an effort to expedite allowance of the subject application, applicants respectfully submit that claim 5 has been amended to recite "a source of carbon containing pieces of at least one metal element selected from the group consisting of Zr, Hf and Y." Support for the amendment can be found in claim 5 as originally filed.

Applicants respectfully submit that claim 5 is directed to a process comprising providing a source of carbon containing pieces of at least Zr, Hf or Y. Applicants respectfully submit that Kitabatake does not teach or suggest a process comprising providing a source of carbon containing such pieces. Further, applicants respectfully submit that Coats is cited for its teaching regarding the meaning of the term "room temperature." Coats does not cure the deficiencies of Kitabatake with regard to a source of carbon containing pieces of at least Zr, Hf, or Y. Accordingly, applicants respectfully submit that Kitabatake and Coats, either alone or in combination, do not teach or suggest the process of claim 5.

Applicants respectfully request that the rejection of claim 5 under 35 U.S.C. § 102(b) and/or 35 U.S.C. § 103(a) over Kitabatake in view of Coats be withdrawn and further ask that claim 5 be allowed at this time.

VIII. Response to Rejections under 35 U.S.C. § 103(a) over Kitabatake in view of Zhang

Claim 6 has been rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Kitabatake in view of Zhang et al. (*Surface Coatings Technology* 1999, 122, 219-224; hereinafter "Zhang"). The Patent Office contends that Kitabatake

teaches a source of carbon containing at least titanium and teaches forming an amorphous carbon via sputtering. The Patent Office further contends that, given that the metal was incorporated into the target, the film would inherently contain metal. The Patent Office concedes that Kitabatake does not disclose a pressure at which the sputtering process is carried out. However, the Patent Office contends that chamber pressure is recognized in the art as affecting properties in the resulting film and the affects the ions traveling from the target as allegedly disclosed in Zhang. The Patent Office further alleges that Zhang teaches chamber pressures of 1.3 Pa. The Patent Office contends that modifying or optimizing the pressure would be well within the skill of the art.

After careful consideration of the rejection and of the Patent Office's comments, applicants respectfully traverse the rejection and offer the following remarks.

Initially, without acquiescing to the rejection and in an effort to expedite allowance of the subject application, applicants respectfully submit that claim 6 has been amended to recite "a source of carbon containing pieces of at least one metal element selected from the group consisting of Zr, Hf and Y." Support for the amendment can be found in claim 6 as originally filed.

Applicants respectfully submit that claim 6 is directed to a process comprising providing a source of carbon containing pieces of at least Zr, Hf or Y. Applicants respectfully submit that Kitabatake does not teach or suggest a process comprising providing a source of carbon containing such pieces. Zhang does not cure this deficiency. Accordingly, applicants respectfully submit that Kitabatake and Zhang, either alone or in combination, do not teach or suggest the process of claim 6.

Applicants respectfully request that the rejection of claim 6 under 35 U.S.C. § 103(a) over Kitabatake in view of Zhang be withdrawn and further ask that claim 6 be allowed at this time.

IX. New Claims

New claims 12 and 13 have been added.

New claim 12 recites the hydrogen storage material of claim 1 wherein the at least one metal element is Y. New claim 13 recites the hydrogen storage material of

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claim 2 wherein the at least one metal element is Y. Support for the new claims can be found in claims 1 and 2 as originally filed.

No new matter has been added. Applicants respectfully submit that new claims 12 and 13 are in condition for allowance and respectfully request a Notice of Allowance to that effect.

CONCLUSIONS

Should there be any minor issues outstanding in this matter the Examiner is respectfully requested to telephone the undersigned attorney. Early passage of the subject application to issue is earnestly solicited.

DEPOSIT ACCOUNT

The Commissioner is hereby authorized to charge any other fees associated with the filing of this correspondence to Deposit Account Number 50-0426.

Respectfully submitted,

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